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ABSTRACT

This study examined the teacher's role in creating a gender-sensitive environment in an all girls physics class and the effects of that environment on girls' achievement, self-concept, and career choices. Reflective journaling by the teacher-researcher was used to discover, analyze, and challenge appropriate teaching strategies and personal biases. Extensive descriptions of the daily operation of the class are employed in an ethnographic methodology to develop a portrait of a classroom environment that is evolving, while revealing its gender sensitive and gender bias aspects and their effects on the girls. Additional data sources include student work, pre- and post-class surveys, student journals, informal conversations with students, and post-class interviews. The vignettes, field note descriptions, and excerpts from reflective journals included describe the growth and development of the girls and the teacher. Findings indicate that each intersection of girls' needs and the teacher's role demonstrated the twin requirements of teacher recognition of the girls' needs and teacher knowledge of intervention strategies to address the need, fulfill the expectations of the girls and the teacher, and create the environment necessary for continued growth and learning. It was concluded that the factors identified in the literature as critical to girls in their science education are evident in a gender-sensitive classroom. (JRH)

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INSIDE A GENDER-SENSITIVE CLASSROOM: AN ALL GIRLS PHYSICS CLASS

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INTRODUCTION

The under-representation of women and girls in science course work and careers is well documented (AAUW, 1992; National Science Foundation, 1992; Oakes, 1990). While science education reform is grappling with this issue, many decisions are gender-blind rather than gender-sensitive. Gender sensitivity requires educators to deal with issues pertaining to girls and their education rather than merely equalizing treatment of males and females in an effort to achieve educational equity (Martin, 1992).

One effort to provide gender sensitivity is an all girls section of physics, in which key elements of a gender sensitive approach are addressed (Hansen, Walker & Flom, 1995; Martin, 1992). A teacher-researcher in a public high school is doing just that with a commercially available physics curriculum and modifications that 1) utilize female-appropriate teaching and learning strategies and approaches to science, 2) address the needs and experiences of girls, 3) emphasize the importance of social dynamics in the construction and monitoring of classroom environment necessary to ensure equitable science experiences, 4) acknowledge the contributions of and barriers to women in science, 5) incorporate the impact of private and personal aspects of girls lives on their educational experiences and their futures, and 6) seek to remove the barriers to science, science education and science careers for girls.

OBJECTIVES

While all-girls education exists in some places at various

grade levels, descriptions of its character are not common in the literature. A new awareness generated by several researchers about the existence of gender bias (Hansen, Walker & Flom, 1995; Sadker & Sadker, 1994; AAUW, 1992) and its flip side gender sensitivity (Martin, 1992) has raised new questions about consciously orchestrated all-girls education and its effects on girls' achievement, self-concept and career choices. This paper initiates a process of addressing these questions by examining the teacher's role in specifically creating a gender sensitive environment in an all girls physics class and the effects of that environment on the girls.

METHODS, SETTING AND PARTICIPANTS

Reflective journaling by the teacher-researcher is used to discover, analyze and challenge appropriate teaching strategies and personal biases as well as to ask questions and seek answers to the day-to-day struggles of teaching in a change-generating environment. Extensive descriptions of the daily operation of the class are employed in an ethnographic methodology to develop a portrait of classroom environment that is evolving, revealing its gender sensitive and gender bias aspects and their effects on the girls. Additional data sources include student work--laboratory notebooks, tests, class assignments, as well as pre- and post class surveys, student journals, informal conversations with students and post-class interviews.

The study site is a small, traditional, rural, public high school of around 400 ninth through twelfth grade students.

Physical science, using Paul Hewitt's **Conceptual Physics**, is the required tenth grade science course. The all girls class is a volunteer population representing approximately 20% of the sophomore class. While girls at this school have been taking college-bound, elective physics in approximately equal numbers to boys for many years, this class was developed to determine what characteristics of 1) classroom environment, 2) instructional practices, and 3) curricular materials best supported girls' learning in a physical science, especially one--physics--which is a traditional gatekeeping course for most science careers.

THEORETICAL FRAMEWORK

The work of Martin (1992) and Hansen, Walker and Flom (1995) catalogs girls' needs in learning science and the elements of the environment they need for successful participation in science. For the purpose of this work girls' needs are described in four categories--1) celebrate girls' strong identity" (Hansen, Walker & Flom, 1995), 2) respect girls as central players (Hansen, Walker & Flom, 1995), 3) develop female appropriate skills and learning strategies, and 4) acknowledge and remove barriers. For the purpose of this paper, celebrations of girls's strong identity encompasses both the acceptance and valuing of the multiple identities each girl brings with her to class each day (Hansen, Walker & Flom, 1995), and the acknowledgment of the private and personal aspects of girls' lives that impact their educational needs and experiences (Martin, 1992). Respecting girls as central players provides each girl with acceptance and

inclusion as an important participant in the academic and social life of the school (Hansen, Walker & Flom, 1995). In the classroom this ideal demands a recognition of and an emphasis on the social dynamics in the construction and monitoring of learning (Martin, 1992). Appropriate learning skills for girls include participation strategies, supporting skills--especially with equipment and computers, cooperative learning situations, reflective analysis skills and self-empowerment skills. Barriers and achievements of women in science, historically and presently, provide coping strategies and realistic career paths for girls' future endeavors. With foreknowledge of visible barriers and foreshadowing of hidden barriers girls can negotiate their own future paths and light the way for those who follow them.

The reality of teaching identifies classroom environment, instructional practice and curricular materials as fundamental to the art and science of teaching. It is the role of the teacher to integrate these elements into an appropriate atmosphere to maximize student learning.

The intersection of girls' needs and teacher's role in the creation of a gender sensitive environment in this study form a four by three analysis matrix. The vignettes, field note descriptions and excerpts from reflective journal entries reported below use some of these intersections to describe the growth and development of the girls and the teacher in their mutual, ongoing process of creating a gender sensitive teaching and learning environment.

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SCENES FROM THE CLASSROOM

Celebrating Identity and Classroom Environment. Establishing a classroom environment that celebrates all that girls are and all they bring with them to class requires the teacher of an all girls class to expand her views on how certain activities take place.

Videos are an educational tool which to bring real life experience to the classroom or illustrate concepts that are not easily demonstrated in the classroom. When not required to take notes about the content of the video, the girls in this all girls class exhibit an interesting set of behaviors.

As the video begins about a third of the class abandons her desk for a seat on the floor. The girls form several single-file lines, one seated behind the other. Height seems to play no role in the order. The video plays while the girls begin smoothing and stroking the hair of the girl in from of her, frequently combing the hair with fingers. When the hair is sufficiently even in texture and if the hair is of an appropriate length, braiding may begin. Most often a single French braid is executed. A French braid requires inclusion of all the hair from the crown to the ends be incorporated into the braid, requiring additional smoothing, combing, and patting. If a tie or elastic is not available to secure the ends, the braid may be finger combed out and the hair left free but smooth, silky and flat, or be self wound into a knot at the back or top of the head and secured with a pencil.

If the video is sufficiently long, at some point in the grooming process the girls change positions so that the first girl may groom one of the other's hair and the last girl may be groomed. The shuffle is done quietly so as not to disturb the other watchers or attract attention to the process. No order of dominance is apparent.

Occasionally back rubbing will replace the hair grooming behavior at one or more spots in the line.

These behaviors demonstrate a level of trust and caring among the girls. The girls' dedication to excellence demonstrated in their grades indicates that these behaviors do

not interfere with their learning from this educational format. However, these behaviors are distinct indication of their strong identity as females and incorporates an important aspect of their personal and private lives in their classroom interaction.

Social Dynamics, Respect as Central Players and Classroom Environment. While a class of only girls in a public high school is rare since the advent of Title IX, Female Physical Science at our school is a statement of respect for girls as central players in science, not only because the class is taught in an academically challenging way by a woman with a doctorate in science education, but also because the administration and counseling staff recognized the need and importance of this class for girls. Girls are respected as central players--the only players in this class.

I began the class with "I'd like you to work with the following partners today as we do this lab." After naming the partners and completing the instructions for the lab I dismissed the girls to the lab room which adjoins my classroom.

Most of them filed out to the lab, but a few surrounded my demonstration table-desk waiting for my individual attention. One asked, "May I work with Marie? I know she is not in my group, but she really helps me with the math." I reaffirmed by desire for her to work with the partner I had assigned and looked to the next girl.

In a whispery voice she said, "I can't work with Amy. She doesn't like me and we don't get along." I suggest that this is a good time for her and Amy to work out their differences and mend fences. I can tell she is not happy and her efforts in this lab will be half-hearted at best.

Having overheard my pronouncements to their classmates the other girls head out to the lab, get in the vicinity of the partners and try to look like some learning is happening.

I check the attendance sheet and look up to find one girl has not reported to the lab at all. I go over to her, sit in the desk next to hers and ask her why she is not doing the lab.

"I will not work with Karen. I had a fight with her in fifth grade and ever since then she has been mean to me." she informs me.

I try to determine if there is a possibility, now five years later, of rebuilding what this girl says was a best friendship. Instead I get "I would rather take a zero than work with her." Defiance stains her face.

I move out to the lab area to supervise the girls' work. Another girl, who seems to be waiting for me to emerge from the classroom, approaches. "Susan has spread rumors about me throughout the whole sophomore class. I can't work with her. Is it okay if I do the lab myself?"

By this time I have made a sweeping assessment of the lab room. It is evident that only a few of the groups are actually doing the lab. The rest of them are pushing equipment around like unwanted peas on a plate.

This problem with lab partners generated a round table discussion of the girls' needs with regard to social interaction. I wanted them to expand their knowledge by learning from and working with all the girls in the class. They had no need to interact with girls who made them uncomfortable. I shared with them professional jealousies I had experienced and witnessed and how I believed that if they could learn to work with a variety of people early in their lives that they might overcome this type of barrier in their future. Combining the strategies, we decided to get to know each other all over again as the women we are now and not the ones we were even last year. We agreed to talk out concerns before they became confrontations. I agreed to allow them to pick partners for the labs we were doing while we were conducting team building exercises, and they agreed to work with a wider circle of classmates as we continued our "getting-to-know-you" process.

Now the girls willing work with any one in the class. They change their seats as their alliances change. And I am careful to assign partners in labs that don't require extensive trust--

labs that require the use of bathroom scales or physical support, such as building people pyramids.

Skills and Strategy Development and Classroom Environment.

"Groups of two or three girls with ramps, balls, meter sticks, stopwatches and notebooks are scattered throughout a long L-shaped corridor talking in soft voices, obviously intent on the work at hand. The occasional roamer in the hall watches for a moment or two and moves on. In general, the girls are too absorbed in their work to more than glance at the roamer and return to work." They have taken over the hall without requesting teacher permission because the girls judge the classroom to be too confining for this lab--the stopping distance of various balls rolled down at ramp positioned at various, increasing angles. They have a job to do and they intend to do it well.

Classroom environment is a function of students and teacher interaction. As students are empowered to make decisions about their learning they become co-creators of the classroom environment. In the instance cited above, the girls knew that the task they were assigned did not fit within the walls of the classroom. Their need to complete the lab successfully superseded the need to follow the teacher directions of using the classroom. Their experiences in the class to that point indicated to them that teacher expectations included their ability to make decisions on how best to complete an assignment, and that such decisions did not require teacher permission. The girls improved the classroom environment by addressing their need.

Barriers and Classroom Environment. While many barriers to girls' education in science education have been recognized, some still lie hidden waiting to ensnare us. My prize student and I experienced just such a trap.

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Sally is a learning disabled student with little or no self-esteem. She even perceives her outstanding athletic ability as being outside her sphere of influence. She was panicked at the thought of taking physical science and did not see an all girls class as any more of a solution to her problem than a mixed gender class. Her special education teacher approached me and Sally's mother with the idea of having Sally take physical science in the all girls class.

During the first few classes Sally sat quietly in her seat, visibly intimidated by the material. She had a few friends from her sports participation, but her lack of self-esteem blocked her from asking for help from them. Just before the first book assignment was due, her special education teacher encouraged her ask me for additional help, because Sally had asked to drop the class.

To ascertain what she knew from the chapter reading, class discussions, demonstrations, and laboratory activities, I began by asking her questions. I quickly discovered that if I framed the questions I asked her in terms of her diving, she had a clear, personal and physical understanding of motion, gravity and free fall. I was amazed at her comprehension because the rest of the class was not nearly this conversant with the concepts. I shared my observations with Sally's mother and her special education teacher. Sally would stay in the class.

She labored for several nights to complete her assignments and prepare for the test. The day of the test Sally struggled with reading and interpreting the questions. I sent her to one of the special education teachers, who would read her the test. It took her two class periods to the class' one to complete the test but she scored one of the highest grades in the class.

We were on our way, or so I thought. Sally did not believe she had succeeded so well on her exam. She saw it as luck, and she pointed out she was already behind on the next chapter.

We continued to work together outside class throughout the first quarter and into the second. I used examples in class that would spark Sally's understanding and as I did so, we seemed to need less out of class time to work.

Sally continued to work very hard on the written assignments, even calling me at home for help on certain sections. As examples continued to come from her experience she understood even the most complex concepts very well.

She earned a B for first quarter, an 89% on a seven point scale. She would smile now when I complimented her on her knowledge and success. She seemed to attack the work with more confidence and she would answer questions in class with confidence in her voice, rather than hiding in her hair mumbling that she did not know.

During the first quarter she had been working out regularly with the local swim club perfecting her diving for the girls' swimming and diving team season whose beginning coincides with the start of the new quarter. We made appointments to work, but they were scheduled over by rearranged, but mandatory diving

practices. No time became convenient, before or after school. A few weekend phone calls did occur but her need to visualize from my little sketches or hand gestures required face to face interaction. In addition, the swimming and diving team (total of eight girls including Sally) would miss class nearly once or twice a week, because girls physical science was scheduled last hour of the school day.

Sally fell further behind missing classwork as well as needed extensive time to do homework. Despite encouragement from her special education teacher and me, she became very discouraged. The last assignment she really tried to complete was keeping a journal as if she were the scientist Carolyn Herschel (her choice of scientist). Just reporting about her life was major job, which I would have accepted but she insisted on doing "the assignment" even though I could not seem to explain it in a way that she understood.

By the end of the semester and the diving season, Sally was back to helplessness and no confidence. She could still do well on tests when the information was couched in terms of her athletic experience, but the missed classwork, lab write ups, book questions and the journal assignment were too much. She disbelieved her success on tests and attributed it to my reading of the test to her. (The special education reader was not her special education teacher and the situation with the reader was tense for reasons I was unable to ascertain.)

On the last class day before semester exams, Sally asked me to sign a change of class form allowing her to transfer to a mixed gender section of physical science with another teacher. In talking with her special education teacher, I was informed that Sally had convinced her mother of the need to change classes. The main reason I was given was that with track coming up she needed a physical science class in the morning so she would not miss as much and by taking her algebra class during the hour female physical science was given, even when she missed class she could get help. because the track coach was a math teacher. I was devastated.

The barriers of scheduling, female physical science at the end of the day and inflexible training schedules for sports were insurmountable for Sally and me. All the swimmers also felt pressured to ask for deadline extensions and extra time to make-up missed classwork, especially because of changing and inflexible practice times. Two other swimmers also transferred at the end of the semester, but not for sports reasons.

The four basketball players faired better. While they too

missed class for athletic contests, they missed less frequently, their practices occurred on a regular schedule and they were allowed flexibility in making up their school work.

The girls who met daily without the interruption of athletic contests faired the best. They knew the concepts well and had no difficulty in completing assignments on time. As much as possible within their groups they provided their athletic peers support and assistance in completing their work. One even came in after school to assist her pals with a lab she had already completed.

Celebrating Identity and Instructional Practice. Learning is enhanced when concepts are presented in a framework of personal experience. High school sophomores are beginning drivers, at the very least taking driver's education if not already possessing a license. Physics traditionally begins with a study of motion. Kids, cars, motion--a logical progression, or is it?

"The girls are not responding well to my use of cars and driving as examples in discussing Newton's first law. And falling objects are even more frustrating."

"The girls presented their shields to each other today. Each shield devoted a quarter of the space to the girl as an individual, a quarter to the girl as a member of her family, a quarter to her in school and a quarter to her as a member of the community. Many of them were artfully done; all of them were thoughtfully done.

Each story was as unique and interesting as the girl who presented it. A few chose not to present, but those who did received a warm response from the group.

I told the girls that I planned to collect the shields and display them on the wall. Even those who did not present did not object to having them displayed so long as names were on the back."

"I've been thinking back over the shields. Nearly every girl in class is involved in some competitive athletic endeavor--there are volleyball players, harriers, swimmers, divers, basketball players, equestrians, cheerleaders, jumpers, tracksters and softball players. While I've always used sports examples in my physics teaching, maybe if I give each girl an example from her experience as I go through demonstrations and explanations they will have a clearer picture of motion and how to apply Newton's law."

As I began not only using sports examples but making reference to each girl's sport, helping her focus on what she feels when doing a particular skill or what happens to the ball when she sets, passes, spikes, dribbles, hits or shots it, the girls began asking more questions about motion. They seemed to be clarifying their understanding by going beyond the conceptual definition in the text to a personal understanding based on their actions and experience. Occasionally they would phrase questions in terms of their sport, showing a desire to build their skills in that sport by understanding the underlying physics. Our horsewomen shared analyses of horse-rider action in jumping and barrel racing with us non-equestrians and occasional riders. There was a dialogue now, not just a one-way stream of meaningless examples. While girls do drive cars, cars and their motion is not inherently interesting to these girls.

Social Dynamics and Instructional Practice. While girls think in terms of groups and relationships, they are as fun-loving and work-avoiding as anyone.

As we worked at the blackboard in the lab room one January day, snow was whiting out the view from the windows. The demonstration on momentum during elastic and inelastic collisions was not keeping their interest, and I felt the lesson lagging. A hand shot up, and as I called on her I hoped for some enlightenment to move the lesson forward. She asked, "If it

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keeps snowing all night and we still have school tomorrow, can we go sledding? We could bring sleds to school tomorrow."

I felt a reprieve. Everyone knows we never have snow days (well 6 in my 17 year career here). We need a break. While we couldn't do collisions on sleds, we could explore mass-velocity relationships with different numbers of people on the sled. I readily agreed, "Yes, let's do that. If we have school tomorrow, bring your coats and boots to class and we'll go sledding."

While we had to share the sledding hill the displaced fifth graders, the girls had an super experience. They grouped and regrouped to check times for various combinations of sledders careening down the hill. They tried a snow board and raced sled versus sled and board versus sled. Some only timed, some timed and rode, all ran some and played some. Heading back to the high school they began with snowball throwing and ended with colliding with shoveled mounds.

In their journal accounts of the sledding and snow lab, they talked of the fun and the freedom. In their lab books, they wrote of the science.

Skills and Strategy Development and Curricular Materials. Amusement parks are the perfect place to teach physics! But how do you bring an amusement park into the classroom? Disney's **Coasters** computer program makes it up close and personal. As the girls approached two days of riding and designing roller coasters in the computer lab, I worried about their computer skills. Other than word processing and some spreadsheet and database applications if they have taken the school's computer literacy course, the girls had few computer skills. They had not used many trial and error skills in physics labs.

As with the boys, I had booted the computers and entered the

program so as to provide as much time a possible for student-coaster interaction. After a few instructions about how to navigate within the program and what information I wanted in the way of a write-up of their work, they were off and running, working in pairs because of the limiting number of computers.

When the girls ran into difficulty maneuvering within the program for riding existing coasters or creating their own coasters, their first response was to look for me or a computer specialist who was present off and on during the activity. We tried to focus their thinking with a series of questions rather than a direct instruction for the next step. After receiving this type of response, they asked the girls at a neighboring computer or began trying alternate approaches of their own.

The greatest breakthrough came with the two girls who are struggling the most in the class second semester. One of them is especially skilled on the computer and they are both roller coaster "freaks". They built several of the highest rated (a function of the computer program itself) roller coasters in the school, exceeding the two computer specialists who had worked for days to create a highly rated coaster.

This noncompetitive computer program/game was very successful in 1) improving the girls' computer skills, 2) diminishing, if only a little, their computer anxiety, and 3) reinforcing concepts of circular motion such as acceleration, lateral g's, centripetal force and banked curves as well as linear motion concepts of free fall and vertical g's. The girls expressed an interest in doing more computer activities and I am seeking more of this type of noncompetitive, engaging, educational program.

Barriers and Curricular Materials. Role models are a critical part of educating girls in science. Some of our best and most easily accessible role models are scientists made known to us through their biographies. Many of the girls chose female scientists for their assignment. While researching the lives of their scientist in order to write a journal from the scientists viewpoint, the girls were able to develop an understanding of the

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barriers the scientist faced as well as the contributions she/he made to the world. The girls demonstrated a great deal of insight into other life styles and time periods as they wrote their journals. This experience has developed their awareness of not only science careers but also how scientists throughout history have managed careers, marriage and parenthood.

RESULTS

The above glimpses of a gender sensitive environment reflect growth and decline, trial and error, success and failure. Each intersection of girls' needs and teacher's role has demonstrated the twin requirements of teacher recognition or acknowledgment of the girls' needs and teacher knowledge of intervention strategies to address the need, fulfill the expectations of the girls and the teacher, and create the environment necessary for continued growth and learning. Teacher knowledge of gender issues, gender sensitive environments, alternative instructional practices and diverse curricular materials is a minimal expectation. Skills in reflection--to recognize subtle signs of various needs, analysis--to identify and apply appropriate remedies in fulfilling those needs, and evaluation--to assess solutions, methods, and materials--constitute the other teacher requirement. Based on these qualifications, the creation of a gender sensitive environment is a demanding, full-time job.

As we look again at the scenes from the classroom we also see growth, empowerment, learning and confidence. The job seems worth the results and may grow even more so with time.

CONCLUSIONS

Factors identified in the literature as critical to girls in their science education are evident in a gender sensitive classroom, where an all girls class of tenth graders studies physics. The preliminary results suggest that the efforts of both students and teacher are worthwhile.

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